

## FROM REQUIREMENTS TO ACCEPTANCE TESTS

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### **Abstract**

From user requirements definition to accepted software system, the software project management wants to be sure that the system will meet the requirements. For the development of a telecommunication satellites Control Centre, C.N.E.S. has used new rules to make the use of tracing matrix easier. From Requirements to Acceptance Tests, each item of a document must have an identifier. A unique matrix traces the system and allows the tracking of the consequences of a change in the requirements.

A tool has been developed, to import documents into a relational data base. Each record of the data base corresponds to an item of a document, the access key is the item identifier. Tracing matrix is also processed, providing automatically links between the different documents. It enables the reading on the same screen of traced items. For example one can read simultaneously the User Requirements items, the corresponding Software Requirements items and the Acceptance Tests.

**Keywords :** Requirements, development, tracing matrix, tool.

## **1. DOCUMENTATION MANAGEMENT**

### **1.1 Identification of requirements**

The problem of identifying precisely the requirements when developing software, is

known by any one who has had to manage a subcontracted development on behalf of a final client : the operational team.

One expects the project manager to answer such question as "what about this requirement, are you sure the modification we wanted has been correctly taken into account, ... ?".

Thus to avoid ambiguity and inaccuracy, for the development of a telecommunication satellites control centre, C.N.E.S. decided as early as 1989 to introduce identifiers in the User Requirement Documents.

### **1.2 Identifiers**

In order to have a representative identification (trying to avoid FRED1253), it was decided that an identifier must contain the acronyms of the main functionality concerned (TM, TC,...) and of the requirement, followed by a number, e.g. TMVISU090 for a requirement dealing with telemetry vizualisation.

### **1.3 Editing rules**

In order to have a tool based on the use of a DataBase Management System, we chose editing rules to allow an automatic feeding of the database. To be followed the rules have to be simple :

- an identifier must be preceded by a carriage return character and followed by a tabulation character,
- when a modification is made to the requirement, the identifier must be preceded by a "&" character in the next version of the document.

## 2. THE DOCUMENT DATABASE

### 2.1 Definition of the database

The need at this stage was to gain an automatic access to an identifier, the main key of the database.

But we also wanted to know :

- which document it comes from,
- which edition/revision of the document,
- which paragraph (number and title) containing it,
- the text of the requirement.

For a requirement subject to a change we also wanted the change request number which it originated from.

### 2.2 The database

With 4<sup>e</sup> DIMENSION® which is a user friendly DBMS running on a Macintosh® we have developed a tool named "TBD-pro" for "Traceur de Besoins durant le Développement - version probatoire".

TBD-pro was designed and developed at C.N.E.S. by M. Studnia, P. Pacholczyk, L. Baize.

To avoid to be dependent on the word processor used to edit the document, the automatic feeding of the database is done on ASCII files. For the first "import" of a document, you create as many records as identifiers, for the next ones you only import into the database the requirements whose identifiers are flagged with "£", the previous records of the database with the same identifier are flagged as invalid.

In order to be able to trace the user requirements with other documents, we followed the same syntactic rules for the Software Requirement Document and for the System Acceptance Tests Document which were added to the database.

FONCTIONS				
Référence	SPACEOPS010	Estat	Valid	
Synthèse	This is an abstract of the requirement			
Autre Référence	SPACEOPS020	DM	1	
Nomenclature	SP-UHD-001	Edition	1	Révision 0
Paragraphe	I.1. Introduction to T.B.D.-pro			
Descriptif	Here is the very precise, testable second version of the user requirement which must illustrate the presentation of TBD-pro at the Second International Symposium on Ground Data Systems for Space Mission Operations.			

## 3. THE TRACING DATABASE

### 3.1 Definition of the tracing matrix

We wanted to cross check the user requirements with the acceptance tests. The acceptance tests are a subset of the validation tests, which have to be checked against the software requirement. Thus it was decided to have a unique matrix containing the user requirements, the software requirements, the corresponding tests and the phases (validation/acceptance) the test is performed. Each identifier is followed by a tabulation character and a carriage return character separates each line of the matrix.

UR Ident.->SR Ident.->Test->PhasesCR

### 3.2 The database

One of the main problems one has, reading a tracing matrix, is that very often the identifiers are not explicit. Thus the only

way to study it, is to have on one side the matrix, on the other side the concerned documents.

As we had the document database, we decided to link the records with the matrix to offer a new matrix presenting the contents of the requirements or tests and not only the identifiers.

Thus a new version of TBD-pro was developed, to include this functionality.

T.B.D. pro		Fiche N°: 017	Imprimer	Quitter	T.B.D. pro
<b>SPECIFICATION de BESOINS</b>					
Référence	SOFTOPS030	Mnémonique	ERD		
Paragraphe	1.1. Introduction to T.B.D.-pro				
Synthèse	This is an abstract of the requirement				
Descriptif	Here is the very precise, testable second version of the user requirement which must illustrate the presentation of TBD pro at the Second International Symposium on Ground Data Systems for Space Mission Operations.				
<b>SPECIFICATION FONCTIONNELLE</b>					
Référence	SOFTOPS030	Mnémonique	ERD		
Paragraphe	2.1 Presentation of the software system				
Descriptif	Here is the very precise, testable second version of the software requirement which must illustrate the presentation of TBD pro at the Second International Symposium on Ground Data Systems for Space Mission Operations.				
<b>DOSSIER de VALIDATION</b>					
Référence	TESTOPS020	Mnémonique	STD		
Paragraphe	1.1 Test of the MMI				
Descriptif	Here is the validation Test which must illustrate the presentation of TBD-pro at the Second International Symposium on Ground Data Systems for Space Mission Operations, testing SOFTOPS030.				
Phases					
Commentaire	This is the first module for the presentation of the requirements and tests of the validation phase.				
Fiche N°	251				

## 4. UTILIZATION OF TBD-pro

### 4.1 Completeness of the matrix

Because the documentation is in the database, TBD-pro offers the automatic check of the completeness of the matrix. You may print and/or store in a file the missing requirements.

### 4.2 Searches in documents

TBD-pro offers the capability of searching through the documents. For instance, one may :

- search requirements involved in a precise change request,
  - rebuild an out of date version of a document,
  - combine searches e.g. one may look for requirements containing strings like "telecommand" and "operator" and not "alarm",
- and then store and/or print the result.

### 4.3 Other facilities

TBD-pro offers the capabilities of searching through the documents on top of searching through the tracing matrix.

One may perform any search he wants through the documents, and get onto the screen the corresponding selection of requirements and/or tests from other documents.

### 4.4 Performances

Our User Requirement Document contains 1100 requirements, whole import takes less than one hour.

The full matrix contains about 4000 lines. It takes about two seconds to change from one line of the matrix to the next one.

Checking that no identifier from a document has been omitted takes about one hour and a half.

### 4.5 Planned upgrades

Up to now, the version of TBD-pro is an interpreted one. In order to gain rapidity, it will be updated, to be compatible with the latest version of 4<sup>e</sup> DIMENSION®, and compiled.

To be widely distributed, it needs to be an industrial product with a real

documentation and not only some developers' notes.

## 5. CONCLUSION

TBD-pro has shown it could be very helpful, because it is exhaustive, simple to use (menus, the result of any search may be stored and/or printed). It is the technical configuration management tool of the project.

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4<sup>e</sup> DIMENSION is a registered trademark of ACI.